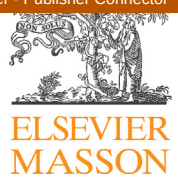
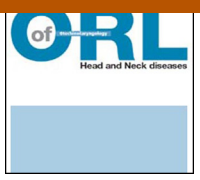
European Annals of Otorhinolaryngology, Head and Neck diseases (2013) 130, 309—311



Available online at
SciVerse ScienceDirect
www.sciencedirect.com
Elsevier Masson France
EM|consulte
www.em-consulte.com/en



ORIGINAL ARTICLE

Role of the ''rising tide sign'' in the diagnosis and assessment of the results of surgery for Zenker's diverticulum

J.-R. Chen[a,b], H. Mirghani[a], A. Jafari[a], O. de Crouy Chanel[a], S. Périé[a], J. Lacau St Guily[a,*]

[a] *Service d'ORL et Chirurgie Cervico-Faciale, Université Pierre et Marie-Curie, Paris 6, Hôpital Tenon, AP—HP, 4, rue de la Chine, 75020 Paris, France*
[b] *Department of Otolaryngology-HNS, RenJi Hospital of Shanghai Jiao-Tong University, 200001 Shanghai, China*

KEYWORDS
Zenker's diverticulum;
Swallowing;
''Rising tide sign'';
Videoendoscopy swallowing study

Summary
Objective: To evaluate the role of the videoendoscopic ''rising tide sign'' (RTS) in the diagnosis and assessment of surgical repair of Zenker's diverticulum.
Study design: Retrospective.
Subjects and methods: A total of 148 patients with Zenker's diverticulum underwent surgery in our department. A videoendoscopic swallowing study (VESS) was performed pre- and postoperatively, and the two examinations compared for the presence of the RTS. VESS characteristics based on the time to RTS onset and the size of diverticulum, as seen on a barium swallow, were also compared in a subset of 38 patients.
Results: All patients presented with the RTS on preoperative VESS. No correlation was observed between the time to onset of the sign and size of the diverticulum. Follow-up data were available for 121 patients (mean follow-up: 8 months): 111 patients were significantly improved during follow-up, with complete disappearance of the RTS. Recurrence of symptoms was observed at this time in 10 patients. Seven of these 10 patients had concomitant recurrence of the RTS and required repeat surgery after a mean follow-up of 37 months.
Conclusion: The RTS observed by videoendoscopy is a supplementary tool for the diagnosis of Zenker's diverticulum and for evaluation of the efficacy of surgery during the postoperative follow-up.

Introduction

Zenker's diverticulum refers to posterior herniation of the pharyngoesophageal mucosa at the junction of the two portions of the inferior constrictor muscle of the pharynx. Clinical symptoms consist of varying degrees of dysphagia

* Corresponding author. Tel.: +33 1 56 01 62 46; fax: +33 1 56 01 70 10.
E-mail address: jean.lacau@tnn.aphp.fr (J. Lacau St Guily).

1879-7296/$ - see front matter © 2013 Elsevier Masson SAS. All rights reserved.
http://dx.doi.org/10.1016/j.anorl.2011.11.005

and regurgitation. Regurgitation (also called 'rumination') is suggestive of Zenker's diverticulum, as the pouch-like diverticulum first traps the food bolus, then releases it into the pharynx. The diagnosis of Zenker's diverticulum is usually suspected on the basis of the patient's symptoms and confirmed by a barium swallow study [1,2]. A videoendoscopic swallowing study (VESS) [3—6] is now commonly used to assess the swallowing process. However, upper esophageal sphincter (UES) function cannot be directly assessed by VESS, which can only suggest UES impairment *via* indirect signs such as pooling of secretions in the piriform sinuses and episodes of aspiration. Previously, we described [7] a specific VESS sign of Zenker's diverticulum called the ''rising tide sign'' (RTS), referring to a rising, wave-like back-flow into the hypopharynx of swallowed puree following its complete disappearance initially. This VESS sign appears to be correlated with the presence of a diverticulum, also confirmed by a barium swallow study [7].

At present, the only curative treatment of the condition is by either endoscopy [8,9] or open surgery.

The aim of the present study was to confirm that the RTS demonstrated by VESS can be used as a supplementary tool for the preoperative diagnosis and postoperative follow-up of Zenker's diverticulum.

Methods

A total of 148 consecutive patients (66 women, 82 men; mean age: 73 years, range: 38—99 years) underwent surgery for symptomatic Zenker's diverticulum between May 1998 and April 2010 in our department, and were included in the present retrospective study.

Clinical examination, a barium swallow study and VESS with a flexible laryngoscope were performed in all patients prior to surgery. Functional assessment of swallowing included an examination while swallowing a dry solid and a puree. Special attention was paid to the presence of an RTS as previously described [7]: the sign is characterized by complete disappearance of the puree from the hypopharynx and piriform sinuses after complete swallowing of the bolus, followed by retrograde reappearance of the puree in the hypopharynx and, finally, disappearance of the regurgitated food with the next swallow. In every case, Zenker's diverticulum was confirmed by the barium swallow study.

The RTS may be observed after a single mouthful or after a variable number of swallowing cycles. The VESS recordings and barium swallow studies of a random subset of 38 patients of the series were retrospectively compared. These patients were classified into three groups according to the time to onset of the RTS on VESS:

- after one swallow;
- after five swallows or less;
- and after more than five swallows.

They were also classified into three types according to the size of the diverticulum on the barium swallow:

- type I = small (< 2 cm);
- type II = moderate (2—5 cm);
- and type III = large (> 5 cm).

The diverticula were treated *via* two types of surgical approach: open surgery and endoscopy. Endoscopic surgery was successful in 120 patients (81%), with a switch to open surgery required in 28 cases (19%) due to difficult exposures.

VESS was repeated 1 month postoperatively in 121 of the 148 patients treated surgically, while 27 patients were lost to follow-up.

Ethical considerations

The study was approved by the Comité de protection des personnes (Committee to Protect People in Biomedical Research) Île-de-France VI, Hôpital Pitié-Salpêtrière.

Results

The RTS was observed preoperatively after swallowing the puree in all patients with Zenker's diverticulum. For the subset of 38 patients, their RTS profiles are presented in Table 1; the RTS was observed on VESS after one swallow in 16 patients, after less than five swallows in 19 patients and after more than five swallows in only three patients. These same patients, classified according to three sizes on the barium swallow, were type I (small) in nine cases, type II (moderate) in 28 cases and type III (large) in only one case. No correlation was observed between the size of the diverticulum and the time to RTS onset.

Surgery consisting of transmucosal UES myotomy (section of the common wall between the diverticulum and esophagus) was successfully performed by endoscopy in 120 patients (81%). The most common technique in this series was Endo-GIA™ transoral stapling ($n = 98$), while other techniques included CO_2 laser endoscopy ($n = 3$), LigaSure® section coagulation ($n = 6$) and Ultracision® ($n = 13$). Endoscopy was converted to an open procedure in

Table 1 Characteristics of patients with Zenker's diverticulum.

		Size of the diverticulum (cm)			
		< 2	2—5	> 5	Total
Time to onset of RTS (number of swallows)	1	5	11	0	16
	2—5	3	16	0	19
	> 5	1	1	1	3
	Total	9	28	1	

28 cases (19%) due to poor endoscopic exposure because of the patients' anatomical features. Open surgery consisted of extramucosal cricopharyngeal myotomy without diverticulectomy.

Two patients developed postoperative complications. One experienced intraoperative perforation of the diverticulum by the stapler tip that was repaired by immediate neck incision, resulting in a postoperative pharyngocutaneous fistula that healed after 2 weeks, with uneventful recovery of oral feeding. The other, a patient taking warfarin who needed open surgery, presented with a neck hematoma on day 3 that required evacuation *via* an open procedure.

Immediate postoperative clinical assessment of swallowing was performed 1 month after the operation. Altogether, 27 patients were lost to follow-up after discharge from hospital. Of the 121 patients who underwent postoperative VESS assessment, major symptomatic improvement was reported by 119 patients, while two considered themselves to still be dysphagic; these two patients and a further two others had persistent RTS, whereas the sign was no longer evident in the remaining 117 patients.

Follow-up data were available for 121 patients with a mean follow-up of 8 months (range: 2—96 months). A total of 111 patients remained symptom-free and were significantly improved, with complete disappearance of the RTS. However, recurrence of symptoms was observed during follow-up in 10 patients. Seven of these 10 with concomitant recurrence of the RTS required reoperation after a mean follow-up of 37 months, followed by postoperative disappearance of the RTS in all seven cases. Surgical revision was not performed in the remaining three patients, who considered their symptoms to be minor, and no recurrence of the RTS was observed. Finally, four patients died due to causes unrelated to Zenker's diverticulum.

Discussion

The diagnosis of Zenker's diverticulum is usually based on the clinical history and a barium swallow study. Barium esophagram (barium swallow) is the most commonly used technique for the diagnosis of esophageal disorders, whereas VESS can be used as a supplementary tool to study dysphagia during dry swallows and the swallowing of foods of various consistencies. Previously, we had reported on the efficacy of VESS for the diagnosis of Zenker's diverticulum [7] and described the RTS as being associated with Zenker's diverticulum. The present study confirms that the sign is a characteristic feature of Zenker's diverticulum.

The present study also demonstrates the lack of correlation between the time to onset of the RTS and the size of Zenker's diverticulum, suggesting that, in addition to the size of the pouch, the shape of the common wall and structure of the cricopharyngeal muscle are also important considerations.

Furthermore, our study confirms that VESS can be used to evaluate the efficacy of surgery in these patients. The RTS sign disappears in most cases after successful surgical correction of Zenker's diverticulum.

During follow-up, 10 patients saw a recurrence of symptoms, and the simultaneous recurrence of the RTS was an indication for surgery in seven of these 10 patients. However, persistence of the diverticulum on a barium swallow is not a reliable sign, as the pouch is not resected by the stapling procedure [9]. This is why assessment of the RTS constitutes a useful functional examination to demonstrate the consequences of the diverticulum in patients with recurrent dysphagia.

Conclusion

VESS provides a non-invasive examination of the swallowing process that can easily be performed in severely impaired and/or elderly patients. The RTS is a characteristic sign of Zenker's diverticulum that correlates with both symptoms and the postoperative outcome. Also, the technique is easily available to otolaryngologists. Thus, we conclude that VESS should be used as a supplementary tool both preoperatively for the diagnosis of Zenker's diverticulum, and postoperatively to evaluate the short- and long-term efficacy of surgery, especially in patients with recurrent symptoms.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.anorl.2011.11.005.

References

[1] Curtis DJ, Cruess DF, Bert T. The cricopharyngeal muscle: a videorecording review. Am J Roentgenol 1984;142:497—500.
[2] Dodds WJ, Logemann JA, Stewart ET. Radiologic assessment of abnormal oral and pharyngeal stages of swallowing. Am J Roentgenol 1990;154:965—74.
[3] Bastian RW. The videoendoscopic swallowing study: an alternative and partner to the videofluoroscopic swallowing study. Dysphagia 1993;8:359—67.
[4] Langmore SE, Schatz K, Olsen N. Fiberoptic endoscopic examination of swallowing safety: a new procedure. Dysphagia 1988;2:216—9.
[5] Rosevear WH, Hamlet SL. Flexible fiberoptic laryngoscopy used to assess swallowing function. Ear Nose Throat J 1991;70:498—500.
[6] Périé S, Laccourreye L, Flahault A, et al. Role of videoendoscopy in assessment of pharyngeal function in oropharyngeal dysphagia: comparison with videofluoroscopy and manometry. Laryngoscope 1998;108:1712—6.
[7] Périé S, Dernis HP, Monceaux G, et al. The ''sign of the rising tide'' during swallowing fiberoscopy: a specific manifestation of Zenker's diverticulum. Ann Otol Rhinol Laryngol 1999;108:296—9.
[8] Van Overbeek JJ. Meditation on the pathogenesis of hypopharyngeal (Zenker's) diverticulum and a report of endoscopic treatment in 545 patients. Ann Otol Rhinol Laryngol 1994;103:178—85.
[9] Scher RL, Richtsmeier WJ. Endoscopic staple-assisted esophagodiverticulostomy for Zenker's diverticulum. Laryngoscope 1996;106:951—6.